Joint Theater Air and Missile Defense System of Systems Next Generation Interoperability Testing Improvements

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Joint Distributed Engineering Plant Division
Joint Interoperability Test Command

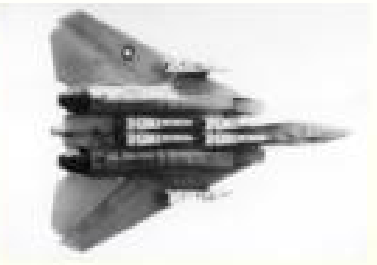
Agenda

- Directives and Policy
- TAMD System Certification
- TDL Certification Process
- Engineering the Change
- Conclusions

Joint TAMD Systems














Historical TAMD System Certification

- TDL (TADIL, USMTF, VMF) joint certification
- Test for Military Standard (MILSTD) compliance
- Tests conducted primarily in laboratory environment
- Primarily support fielded systems undergoing HW & SW upgrades
- Certification recommendations made by test agencies; certification decisions made by JITC

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Joint Interoperability Directives

DODD 4630.5

Forces must have interoperable IT/NSS

DODD 5105.19

DISA shall ensure end-to-end interoperability.

CJCSI 6212.01B

JITC is the sole IT/NSS joint interoperability certifier.

JCS Pub 1-02

Interoperability is the ability of systems, units, or forces to provide services to and accept services from other systems, units or forces, and to use the services so exchanged to enable them to operate effectively together.

DODI 4630.8

All IT/NSS are for joint use and shall be certified by DISA in the acquisition process.

CJCSI 3170.01B

Mandates interoperability KPP for CRDs and ORDs.

DOD 5000.1

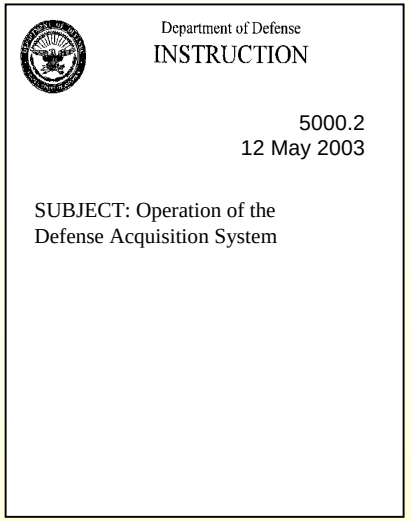
Systems, units, and forces shall shall effectively interoperate with other U.S. Forces and coalition partners.

5000.2 Guidance

Applies to:

- All DoD MDAPs
- Programs on OSD T&E Oversight list
- Post-acquisition (legacy) systems
- All programs & systems that interoperate with them

Dated 12 May 2003



Department of Defense
INSTRUCTION

5000.2
12 May 2003

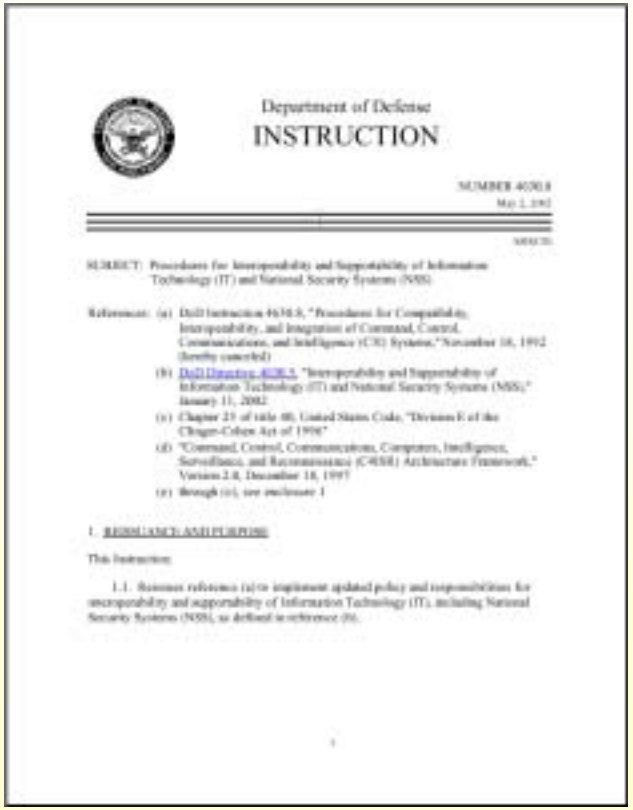
SUBJECT: Operation of the Defense Acquisition System

"All acquisition programs shall satisfactorily address interoperability and integration. Users shall specify, and the appropriate authority shall validate, thresholds and objectives during the requirements generation process."

For IT systems, including NSS, with interoperability requirements, the Joint Interoperability Test Command (JITC) shall provide system interoperability test certification memoranda to the Director, Joint Staff J-6, throughout the system life-cycle and regardless of ACAT.

DoDI 4630.8
Interoperability Requirement

- **Interoperability KPP shall be defined** during the requirements definition and validation process.
- **Certification shall be successfully completed prior to fielding**.
- Heads of DoD Components shall … submit to DISA (JITC) for certification, those systems acquired or modified through non-ACAT acquisitions or procurements (ACTD, C2IP, etc) … and fielded systems when modified with changes to requirements, interfacing systems or supportability.

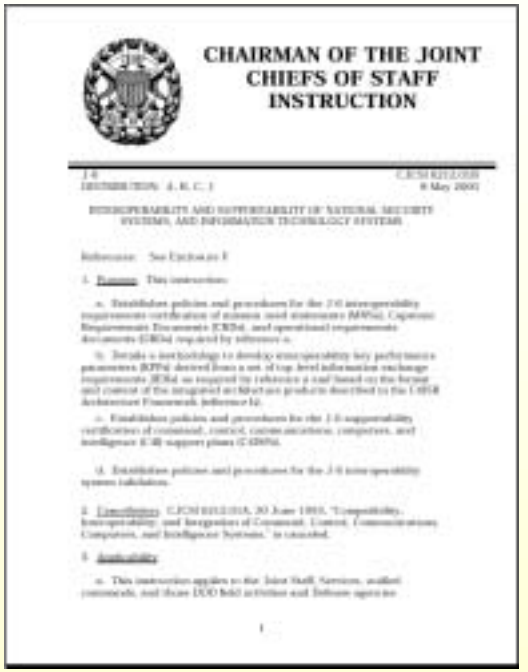


Department of Defense
INSTRUCTION

SUBJECT: Procedures for Interoperability and Supportability of Information Technology (IT) and National Security Systems (NSS)

CJCSI 6212.01B
Test/Certification Guidance

- DISA (JITC) evaluates interoperability in the **most operational realistic environment possible.**
- …determine if the system conforms to applicable standards
- …data collected is adequate for evaluating interoperability issues.



CHAIRMAN OF THE JOINT CHIEFS OF STAFF INSTRUCTION

- **Interoperability for each system will be based on testing the Interoperability KPP.**
- Typically the threshold criterion for the interoperability KPP will be 100 percent (I-KPP = 100% Top Level Critical IERs)

Current TAMD System Certification

- Conduct system level certifications
- Test to Joint Staff certified requirements
- Provide operationally realistic and affordable testing
- Support legacy as well as traditional and non traditional acquisitions
- Document incremental system progress toward certification
- Use Interoperability Certification Evaluation Plan (ICEP) as system certification vehicle where applicable

Categories & Environments

Categories

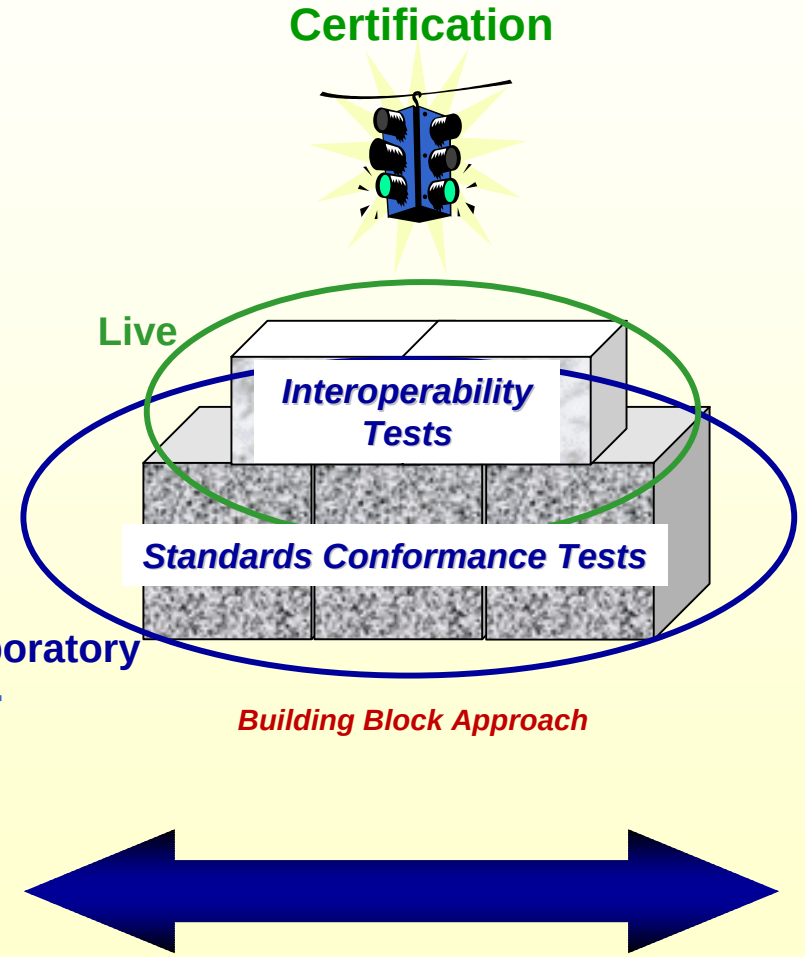
1. Standards Conformance

Standards conformance is the ability to adhere to rules contained in the applicable standards.

2. Joint Interoperability

Ensure that system effectively exchanges information with joint participants in both environments.

Note: MIL-STDs provide a necessary building block for ensuring interoperability, but are not sufficient to ensure that systems are interoperable in a joint environment.



Environments

1. Laboratory/HWIL

Comprehensive data collection for multiple tests under controlled conditions. Can include realistic loads and Hardware In The Loop. Test asset availability provides a representative sample of joint service participation.

2. Live Exercise/OT Event

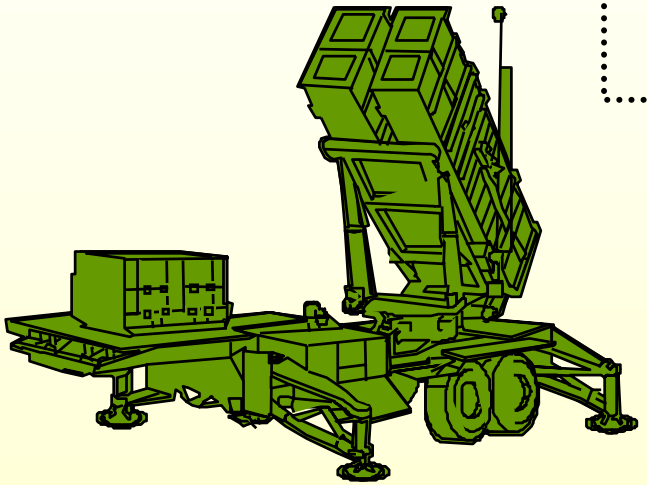
Tests ability to effectively exchange information with joint participants in an exercise or test environment with conditions as realistic as possible. Ensures end-to-end interoperability (after component integration) to assure total system interoperability effectiveness

Tests are conducted in the appropriate environment to address both categories of interoperability

TDL Certification Process

- **Service Level Standards Conformance Testing (SCT) in one-on-one or distributed testbed**

Standards Conformance Test



LINK 11 / 11B / 16

TDL Certification Process

- Service Level Standards Conformance Testing (SCT) in one-on-one or distributed testbed
- **Services nominate a 'representative' C4I system as system under test (SUT) or participant**

TDL Certification Process

- Service Level Standards Conformance Testing (SCT) in one-on-one or distributed testbed
- Services nominate a ‘representative’ C4I system as system under test (SUT) or participant
- **Joint Interoperability Test (JIT) -- SCT in joint distributed testbed**

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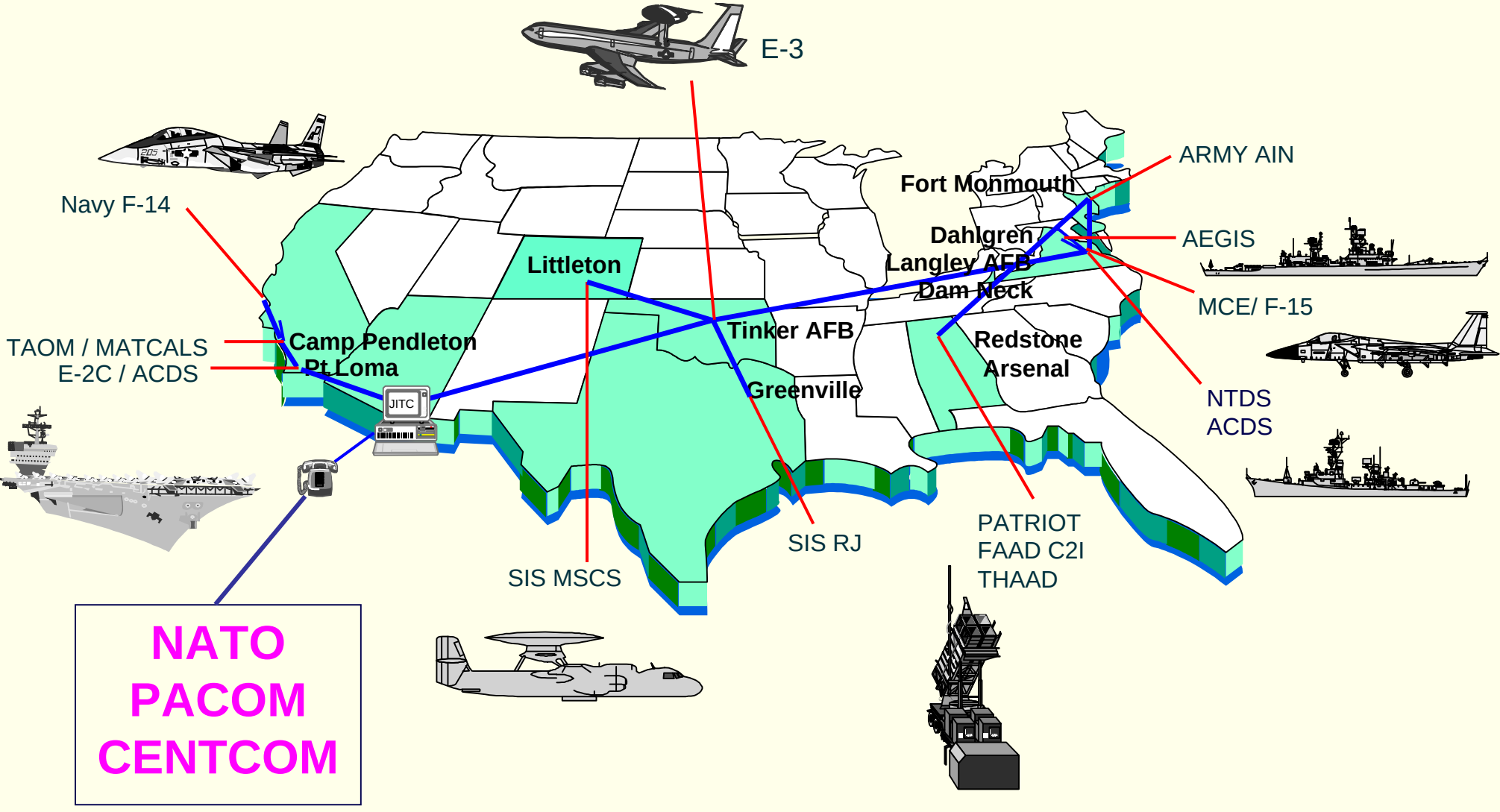
Joint TDL Distributed Network

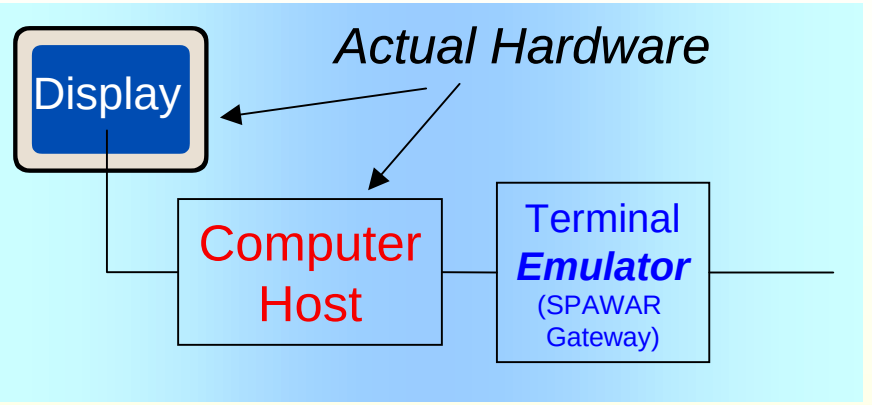


TDL Certification Process

- Service Level Standards Conformance Testing (SCT) in one-on-one or distributed testbed
- Services nominate a ‘representative’ C4I system as system under test (SUT) or participant
- Joint Interoperability Test (JIT) -- SCT in joint distributed testbed
- **Test Report & Certification Status Distributed**

Current JIT Limitations

- Hardware does not include entire data path.
- Limited testing of:
  - Correlation
  - Data Registration
  - Reporting Responsibility Shifts
  - Network Loading
  - Accuracy



- Less than operationally realistic scenarios, and equipment lay down to represent operational architectures
- Single interface focused
  - TADIL/TIBS/VMF/USMTF
  - Not - 1553, X.25, Serial, Socket, Satellite

Current data and analysis available as a result of JITs is necessary but not sufficient in and of itself to determine interface or system interoperability

Engineering Topics

- Define Operationally Realistic Testing
- Simulation and Distributed Testing Requirements
- Next Generation Architecture.
- Take Away

CJCSI 6212.01B

Test/Certification Guidance

- **DISA (JITC) evaluates interoperability in the most operational realistic environment possible.**
- …determine if the system conforms to applicable standards
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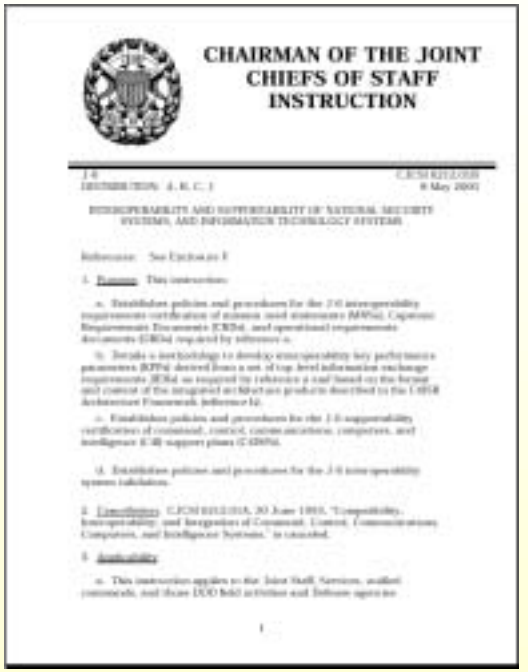

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- Interoperability for each system will be based on testing the Interoperability KPP.
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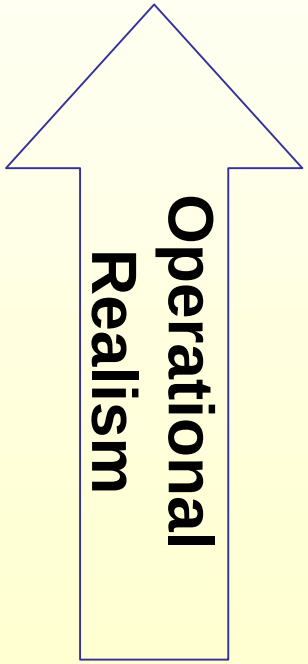
JITC Testing Concept

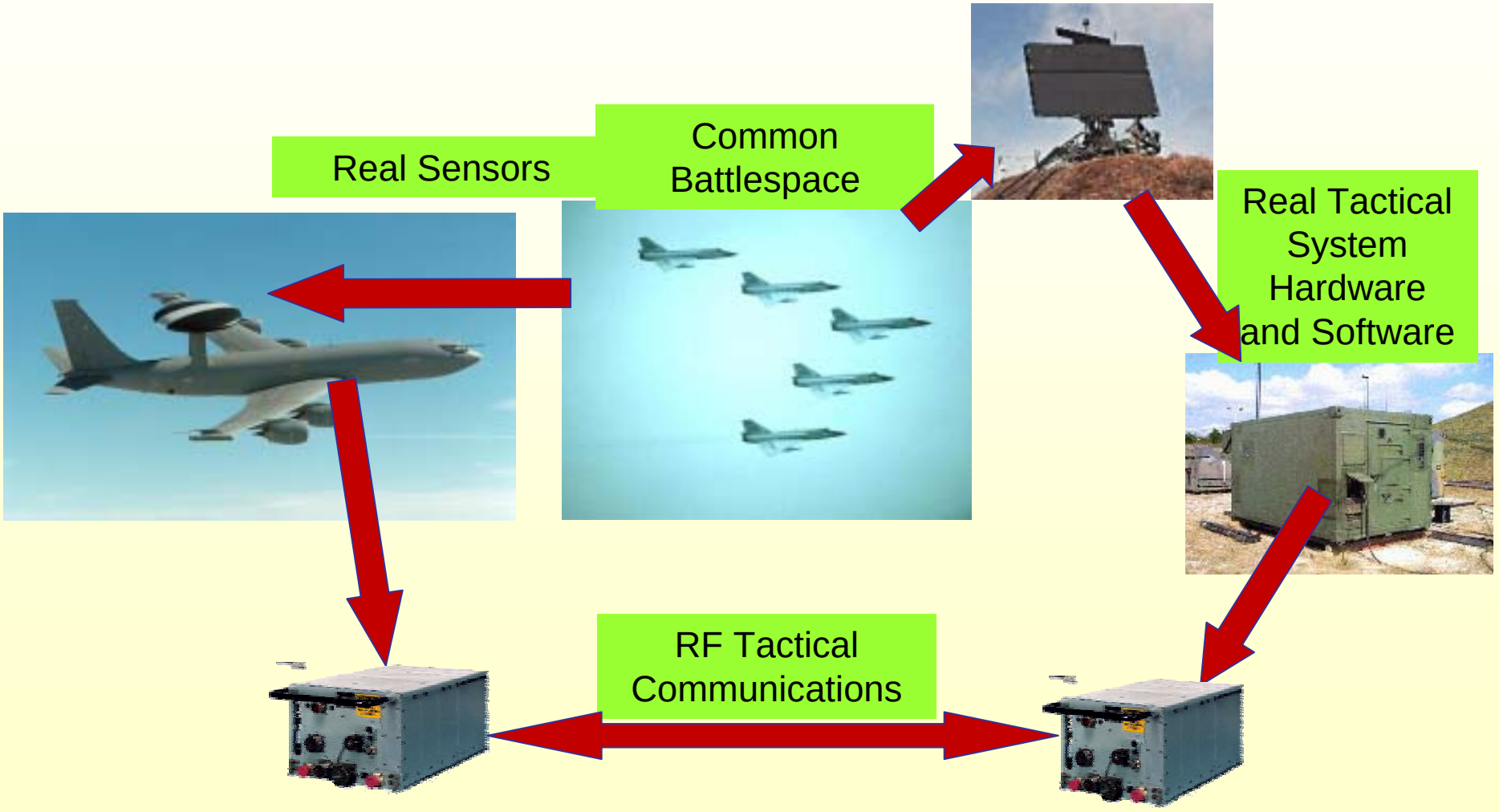
Operational Assessment



Standards Conformance Testing

Scenarios	Simulation Fidelity	Network Requirements
Common Ref. Scenarios	Medium	High
Functional Mission Area	High	Medium
Network Loading	Medium	High
TBM LEP/IPP Accuracy	High	Low
PPLI Accuracy	High	Low
Data Registration	High	Low
TQ Analysis	High	Low
Correlation/Decorrelation	High	Low
ID Processing	Low	Low
IFF Processing	Low	Low
R2 Rules	Low	Low
T/R Rules	Low	Low
Content Format	Low	Low

Live System Testing



Distributed System Testing

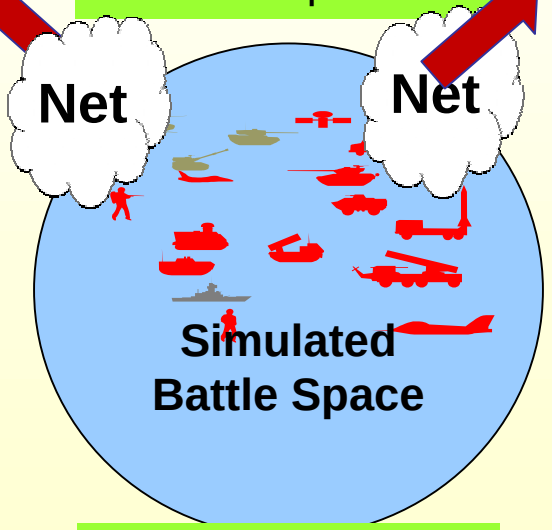
Simulated Sensors

Simulated Sensors

Common Battlespace

Real Tactical System Hardware and Software

Real Tactical System Hardware and Software



Simulated Tactical Communications

Net

Stimulation Fidelity

- **Sensor Simulation**
  - **Same Hardware path as actual sensor**
  - **Model a sensors actual performance**
    - **Range, Rotation, look angles**
    - **Track Quality Feedback**
  - **Responsibility of the Service**
    - **JITC can provide guidance**
- **Tactical Comm. Emulation**
  - **Same Hardware path as actual Terminal**
  - **Within Limits of the WAN**

Distributed Testing Needs

- **Reusability**
  - **Composed of Federates**
  - **Federation agreements**
  - **DIS, HLA, and TENA**
- **Adequate Network services**
  - **Latency**
  - **Bandwidth**
- **Temporary Sites**

Federations

- **Reusable Framework:**
  - **Standardized Architecture**
    - **Approximately 40 Federates building to the JDEP Framework at 15 sites.**
  - **Agreements: JDEP Events have a Federation Agreement**
  - **Services: Time Management, Ownership**

DIS

- **Relatively Plug-and-play**
  - **Adhere to the DIS protocol & be interoperable**
- **Difficult to apply outside it's intended area**
  - **Does Entities well**
  - **Not so good for interactions, ownership**
- **Runs only in Real-time**

HLA

- **Not plug-and-play!**
  - **There is no HLA "protocol," only a standardized set of services**
- **Runs slower/faster or in real time**
- **Flexible to solve many applications**
- **Supports reliable protocols**

- **Run-Time Interface (RTI) products are NOT Interoperable**
- **Requires more software maintenance**

HLA

- **Not plug-and-play!**
  - **There is no HLA "protocol," only a standardized set of services**
- **Flexible to solve many applications**
- **Time Managed - Runs slower/faster or in real time**
- **RTI products are NOT Interoperable**

TENA

- **HLA++**
  - **Works with HLA**
  - **Has more services**
- **Government owned**
- **Open Source**

Network Latencies

200+ ms	Infrequent and imprecise interaction (e.g., observing faraway and/or slow-moving objects)
100 ms	Interaction at moderate ranges or on moderate time scales (e.g., observing fast-moving tanks at 100+ meters)
50 ms	Interactions at close ranges on short time scales (e.g., formation flying and space station docking maneuvers)
Low latency and specialized network services	Tightly coupled close interactions and complex interactions between numerous systems (e.g., short-range multi-ship air-to-air engagements and constructive and interactive war games such as Combined Arms Support Task Force Evaluation Model [CASTFOREM] and Ground Warfare Simulation [GRWSIM])

Network Latencies

- **DISN-LES (JDEP)**
  - CONUS <80 ms Coast-to-Coast
  - Fully Meshed
  - $10/month Typical - 10 mbps
- **Dedicated T1**
  - CONUS <120 ms Coast-to-Coast
  - IP Routed
  - $5k/month typical
- **LANs**
  - Millisecond service
  - 100 mbps - inexpensive

Bandwidth Requirements Drivers

- **During Test**
  - **Truth Data**
    - Standard Conformance Scenarios
    - Functional Mission Area
    - Operational Scenario - SIAP Common Ref. Scenario
  - **Tactical Comms**
    - Link 16, Link 11A/B, TIBS, TDDS, VMF, voice
- **Non-Test Time**
  - **Higher BW just speeds up the process**
    - Data Collection/Scenario Downloads

Bandwidth Requirements

Standards Conformance Testing			
	Track Loads		**Bandwidth (kbps)**
Fast movers	1	Truth Data	55
Moderate Movers	12	Link 16	16
Slow Movers	16	Link 11	15
Total Track Load	**29**	Total Bandwidth	**86**
Functional Mission Area Testing			
Fast movers	2	Truth Data	542
Moderate Movers	62	Link 16	85
Slow Movers	48	Link 11	96
Total Track Load	**112**	Total Bandwidth	**723**
SIAP Common Reference Scenario			
Fast movers	60	Truth Data	4611
Moderate Movers	243	Link 16	129
Slow Movers	16	Link 11	149
Total Track Load	**319**	Total Bandwidth	**4889**

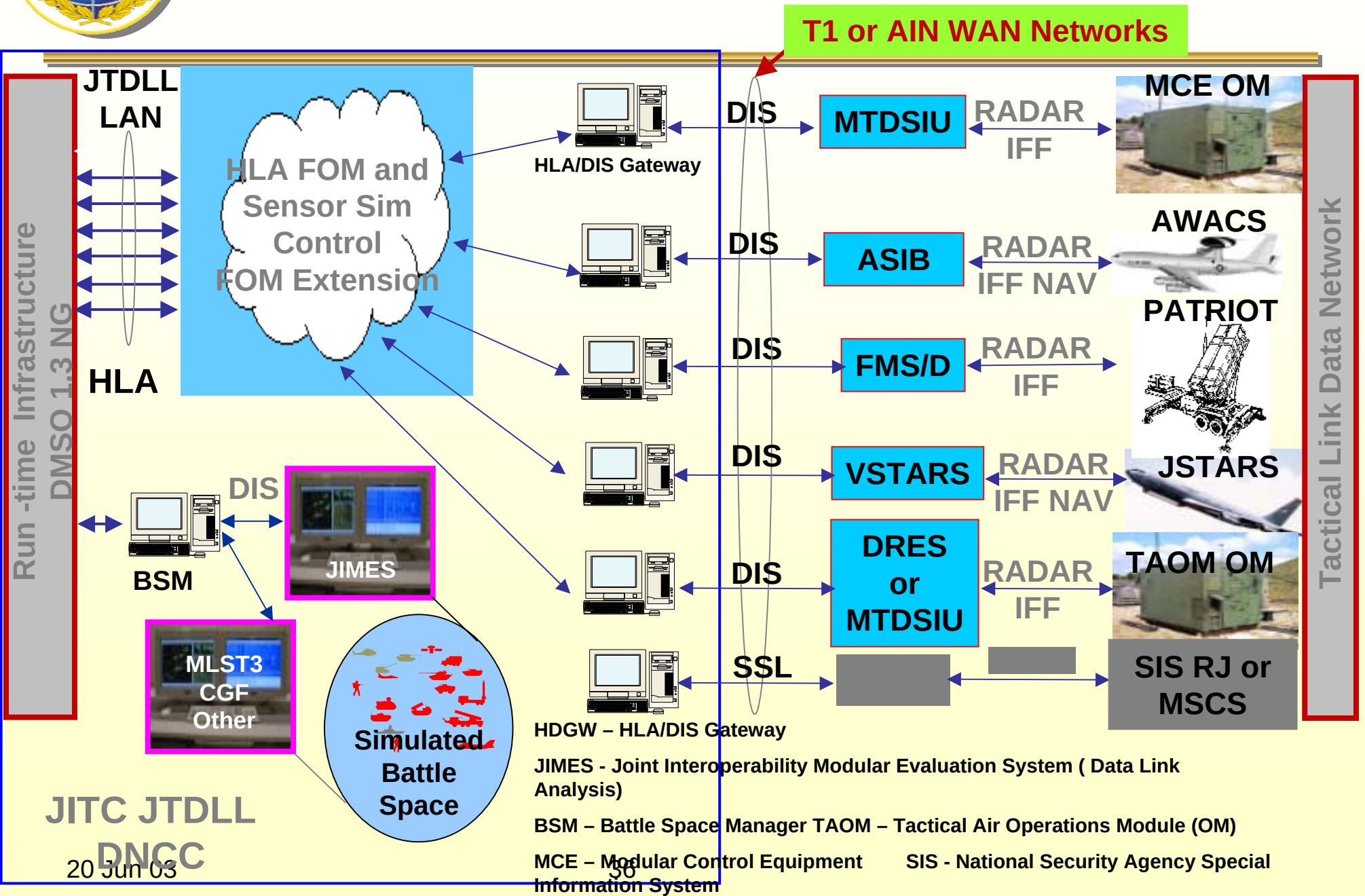
Temporary Sites

- **Fly-Away Interface Packages**
  - **A complete package with comm. Equipment, Crypto, Link 16, Link 11, voice.**
  - **Based on Air Force ROCS system**
  - **2 in procurement**
- **Temporary Circuits - ISDN**

Next Generation Architecture

- **PROBLEM: Current Architecture Requires Expensive Network to Run Operationally Realistic Scenarios**
  - **5 mbps required**
- **PROBLEM: Excessive Latencies Cannot Meet the Needs of Interactive Simulations**
  - **Engagement Coordination – Kill Assessment**

Current Architecture



HDGW – HLA/DIS Gateway

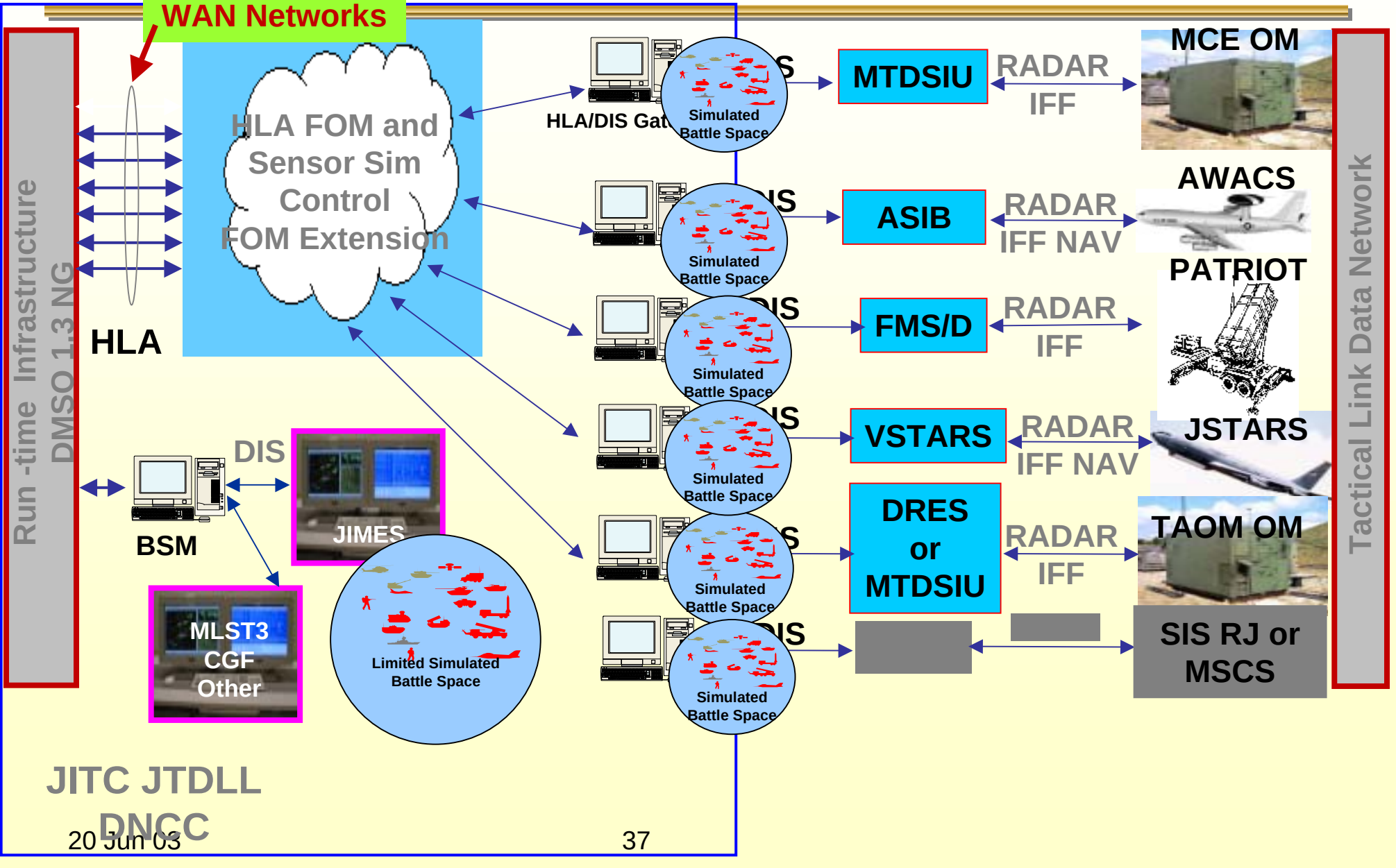
JIMES - Joint Interoperability Modular Evaluation System (Data Link Analysis)

BSM – Battle Space Manager TAOM – Tactical Air Operations Module (OM)

MCE – Modular Control Equipment SIS - National Security Agency Special Information System

JITC JTDLL DNCC

Remote Gateway & Environment Architecture



Bandwidth Advantages

Standards Conformance Testing			
Current Architecture	width (kbps)	Next Generation	Bandwidth (kbps)
Truth Data	55		5
Link 16	16		16
Link 11	15		15
Total Bandwidth	**86**		**36**
Functional Mission Area Testing			
Truth Data	542		5
Link 16	85		85
Link 11	96		96
Total Bandwidth	**723**		**186**
SIAP Common Reference Scenario			
Truth Data	4611		10
Link 16	129		129
Link 11	149		149
Total Bandwidth	**4889**		**288**

Remote G&E Advantages

- Reduced bandwidth need
- Meet Kill Assessment Response Requirements
- Saves money

Brief Take Aways

- **JITC Certification**
  - **It's mandated**
  - **Systems are required to fund**
- **Understand your requirements and your architecture**
  - **Limitation can be overcome with a good design**
  - **One technology/network… does not work for all**
  - **Instrument your architecture as well as the SUT**